What is claimed is:

1. A method for operating a mass analyzer, the method comprising:

a) introducing a sample of ions along an ion path extending from a source of ions to the mass analyzer;

b) accumulating ions derived from the sample of ions during a sampling time interval;

c) detecting ions derived from the sample of ions;

d) determining an injection time interval based on the detecting and the sampling time interval, the injection time interval representing a time interval for obtaining a predetermined population of ions;

e) accumulating ions for a time corresponding to the injection time interval; and

f) introducing ions derived from the accumulated ions into the mass analyzer.

2. The method of claim 1, wherein:

the steps (a) through (f) are performed in the order recited.

3. The method of claim 1, wherein:

the sample of ions and the ions are accumulated in steps (b) and (e) in an ion accumulator.

4. The method of claim 3, further comprising:

g) transferring the accumulated ions from the ion accumulator to a storage device before performing step (f).

5. The method of claim 4, wherein:

accumulating ions for a time corresponding to the injection time interval includes accumulating ions during two or more time periods; and

transferring the accumulated ions from the ion accumulator to a storage device includes transferring the accumulated ions from the ion accumulator to the storage device after each of the two or more time periods before performing step (f).

6. The method of claim 5, further comprising:

determining a number of time periods during which ions will be accumulated in step (e); and

wherein steps (e) and (g) are performed the determined number of times before performing step (f).

7. The method of claim 6, wherein:

the injection time interval determined in step (d) represents a time interval for obtaining a predetermined optimum population of precursor ions in the ion accumulator.

8. The method of claim 3, wherein:

the ion accumulator includes a multipole ion guide.

9. The method of claim 8, wherein:

the multipole ion guide is a RF multipole linear ion trap.

10. The method of claim 9, wherein:

detecting ions derived from the sample of ions includes ejecting at least a portion of the ions derived from the sample of ions from the ion accumulator to a detector in a direction transverse to an ion path from the ion accumulator to the mass analyzer.

11. The method of claim 8, wherein:
the multipole ion guide is an RF quadrupole ion trap.

12. The method of claim 3, further comprising:
filtering the sample of ions and the ions with a mass filter before accumulating the ions in steps (b) and (e).

13. The method of claim 12, wherein:
filtering the sample of ions and the ions includes passing the sample of ions and the ions through a multipole device including one or more mass filters.

14. The method of claim 12, wherein:
the mass filter includes a quadrupole device.

15. The method of claim 3, wherein:
step (c) is performed after step (b).

16. The method of claim 3, further comprising:
removing substantially all ions from the ion accumulator before accumulating ions in step (e).

17. The method of claim 3, wherein:
accumulating ions includes receiving ions in the ion accumulator substantially continuously during a single time interval.

18. The method of claim 3, wherein:
the ion accumulator includes a mass spectrometer.

19. The method of claim 1, wherein:

detecting ions derived from the sample of ions includes detecting the charge density of the ions derived from the sample of ions.

20. The method of claim 1, wherein:

detecting ions derived from the sample of ions includes detecting the ion density of the ions derived from the sample of ions.

21. The method of claim 1, wherein:

detecting ions derived from the sample of ions includes detecting ions in the sample of ions.

22. The method of claim 21, wherein:

introducing ions derived from the accumulated ions into the mass analyzer includes introducing at least a portion of the accumulated ions into the mass analyzer.

23. The method of claim 21, further comprising:

generating product ions from the ions accumulated in step (d);

wherein introducing ions derived from the accumulated ions includes introducing at least a portion of the product ions into the mass analyzer.

24. The method of claim 1, further comprising:

generating product ions from ions in the sample of ions; and

generating product ions from the ions accumulated in step (d); wherein

detecting ions derived from the sample of ions includes detecting at least a portion of the product ions generated from ions in the sample of ions; and

introducing ions derived from the accumulated ions into the mass analyzer includes introducing into the mass analyzer at least a portion of the product ions generated from the ions accumulated in step (e).

25. The method of claim 1, wherein:

the mass analyzer is an RF quadrupole ion trap mass spectrometer, a ion cyclotron resonance mass spectrometer, or an orbitrap mass spectrometer.

26. The method of claim 1, wherein:

the source of ions produces a substantially continuous stream of ions.

27. The method of claim 1, wherein:

the source of ions is an atmospheric pressure chemical ionization (APCI) source, an atmospheric pressure photo-ionization (APPI) source, an atmospheric pressure photo-chemical-ionization (APPCI) source, a matrix assisted laser desorption ionization (MALDI) source, an atmospheric pressure MALDI(AP-MALDI) source, an electron impact ionization (EI) source, an electrospray ionization (ESI) source, an electron capture ionization source, a fast atom bombardment source or a secondary ions (SIMS) source.

28. The method of claim 1, further comprising:

determining a mass spectrum of the ions derived from the accumulated ions.

29. The method of claim 28, wherein:

determining a mass spectrum includes scaling intensities of peaks in the mass spectrum according to the injection time interval.

30. A method of controlling an ion population to be analyzed in a mass analyzer, the method comprising:

determining an accumulation period representing a time required to accumulate a predetermined population of ions;

accumulating ions for an injection time interval corresponding to the accumulation period; and

introducing ions derived from the accumulated ions into the mass analyzer.

31. A method of operating a mass analyzer, the method comprising:

controlling a population of ions to be introduced into the mass analyzer by accumulating ions and introducing ions derived from the accumulated ions into the mass analyzer, the ions being accumulated for a time period determined as a function of an ion accumulation rate and a predetermined population of ions, the accumulation rate representing a flow rate of ions from a source of ions into an ion accumulator.

32. The method of claim 31, wherein:

the accumulation rate is measured while the ions are being accumulated.

33. The method of claim 32, wherein:

the accumulation rate is measured by diverting a portion of an ion beam to a detector while the ions are being accumulated.

34. The method of claim 33, wherein:

diverting a portion of an ion beam includes transmitting a portion of the ion beam to an ion accumulator and detecting a signal representative of a remaining portion of the ion beam while the ions are being accumulated.

35. A method of operating a mass analyzer, the method comprising:

a) introducing a first sample of ions from a source of ions into a multiple multipole device;

b) accumulating in an ion accumulator ions derived from the first sample of ions during a sampling time interval;

c) detecting ions derived from the first sample of ions;

d) determining an injection time interval based on the detecting and the sampling time interval, the injection time interval representing a time interval for obtaining a predetermined population of ions;

e) introducing a second sample of ions from the source of ions into the multiple multipole device;

f) accumulating in the ion accumulator ions derived from the second sample of ions for a time corresponding to the injection time interval; and

g) introducing ions derived from the accumulated ions into the mass analyzer.

36. The method of claim 35, further comprising:

generating product ions by fragmenting ions of the second sample of ions in the multiple multipole device;

wherein accumulating ions derived from the second sample of ions includes accumulating at least a portion of the product ions in the ion accumulator.

37. The method of claim 35, wherein:

the ion accumulator is included in the multiple multipole device.

38. A mass analyzing apparatus, comprising:

a source of ions;

a mass analyzer located downstream of the source of ions along an ion path;

an ion accumulator located between the source of ions and the mass analyzer along the ion path;

a detector located to receive ions from the source of ions and configured to generate signals indicative of detecting the received ions; and

a programmable processor in communication with the detector and the ion accumulator, the processor being operable to:

use the detector signals to determine an accumulation period representing a time required to accumulate in the ion accumulator a specified population of ions;

cause the ion accumulator to accumulate ions for an injection time interval corresponding to the accumulation period; and

introduce ions derived from the accumulated ions into the mass analyzer.

39. The apparatus of claim 38, wherein:

the ion accumulator is included in a second mass analyzer.

40. The apparatus of claim 38, further comprising:

a mass filter located between the source of ions and the ion accumulator along the ion path.

41. The apparatus of claim 40, wherein:

the mass filter is included in a multiple multipole device located downstream of the source of ions along the ion path.

42. The apparatus of claim 41, wherein:

the multiple multipole device includes a mass filter and a collision cell.

43. The apparatus of claim 38, wherein:

the detector is located outside of the ion path; and

the ion accumulator is configurable to eject ions linearly along the ion path towards the analyzing mass analyzer or towards the detector in a direction transverse to the ion path.

44. The apparatus of claim 41, further comprising:

a diversion unit located downstream of the multiple multipole device along the ion path, the diversion unit being configurable to divert ions from the ion path towards the detector.

45. The apparatus of claim 38, wherein:

the detector is located along the ion path.

46. The apparatus of claim 45, wherein:

the detector includes a conversion dynode located downstream of the multiple multipole device along the ion path.

47. The apparatus of claim 38, further comprising:

a storage device located downstream of the ion accumulator along the ion path, the storage device being configurable to iteratively receive and accumulate ion samples from the ion accumulator and to eject the accumulated ion samples towards the mass analyzer.

48. The apparatus of claim 38, wherein:

the mass analyzer is an RF quadrupole ion trap mass spectrometer, a ion cyclotron resonance mass spectrometer, or an orbitrap mass spectrometer.

49. The apparatus of claim 38, wherein:

the source of ions is an atmospheric pressure chemical ionization (APCI) source, an atmospheric pressure photo-ionization (APPI) source, an atmospheric pressure photo-chemical-ionization (APPCI) source, a matrix assisted laser desorption ionization (MALDI) source, an atmospheric pressure MALDI(AP-MALDI) source, an electron impact (EI) source, an electrospray ionization (ESI) source, an electron capture ionization source, a fast atom bombardment source or a secondary ions (SIMS) source.

50. A mass analyzing apparatus, comprising:

a source of ions;

an ion cyclotron resonance (ICR) mass spectrometer located downstream of the source of ions along an ion path;

a detector located off of the ion path;

an RF linear quadrupole ion trap located between the source of ions and the ICR mass spectrometer along the ion path, the RF linear quadrupole ion trap being configured to receive ions from the source of ions along the ion path and being configurable to eject ions linearly along the ion path towards the ICR mass spectrometer or towards the detector in a direction transverse to the ion path;

a programmable processor in communication with the detector and the linear ion trap, the processor being operable to:

determine an accumulation period representing a time required to accumulate in the RF linear quadrupole ion trap a specified population of ions;

cause the RF linear quadrupole ion trap to accumulate ions for an injection time interval corresponding to the accumulation period; and

introduce at least a portion of the accumulated ions into the ICR mass spectrometer.

51. The apparatus of claim 50, further comprising:

a multipole mass filter and a multipole collision cell located between the source of ions and the linear ion trap along the ion path.

52. The apparatus of claim 51, further comprising:

a storage device located downstream of the linear ion trap along the ion path, the storage device being configurable to iteratively receive and accumulate ion samples from the linear ion trap and to eject the accumulated ion samples towards the ICR mass spectrometer.

53. A computer program product tangibly embodied on an information carrier for operating a mass analyzer, the product comprising instructions operable to cause apparatus including a mass analyzer operably coupled to a programmable processor to:

a) introduce a sample of ions along an ion path extending from a source of ions to the mass analyzer;

b) accumulate ions derived from the sample of ions during a sampling time interval;

c) detect ions derived from the sample of ions;

d) determine an injection time interval based on the detecting and the sampling time interval, the injection time

interval representing a time interval for obtaining a predetermined population of ions;

e) accumulate ions for a time corresponding to the injection time interval; and

f) introduce ions derived from the accumulated ions into the mass analyzer.

54. The computer program product of claim 53, wherein:

the instructions operable to cause the apparatus to accumulate ions include instructions operable to cause the apparatus to accumulate ions in an ion accumulator.

55. The computer program product of claim 54, further comprising instructions operable to cause apparatus including a mass analyzer operably coupled to a programmable processor to:

g) transfer the accumulated ions from the ion accumulator to a storage device before performing step (f).

56. The computer program product of claim 54, wherein:

the instructions operable to cause the apparatus to accumulate ions for a time corresponding to the injection time interval include instructions operable to cause the apparatus to accumulate ions during two or more time periods; and

the instructions operable to cause the apparatus to transfer at least a portion of the accumulated ions from the ion accumulator to a storage device include instructions to cause the apparatus to transfer at least a portion of the accumulated ions from the ion accumulator to the storage device after each of the two or more time periods before performing step (f).

57. The computer program product of claim 56, further comprising instructions operable to cause apparatus including a mass analyzer operably coupled to a programmable processor to:

determine a number of time periods during which ions will be accumulated in step (e); and

wherein steps (e) and (g) are performed the determined number of times before performing step (f).

58. The computer program product of claim 57, wherein:

the injection time interval determined in step (d) represents a time interval for obtaining a predetermined optimum population of precursor ions in the ion accumulator.

59. The method of claim 54, wherein:

the ion accumulator is a multipole ion guide.

60. The computer program product of claim 59, wherein:

the instructions operable to cause the apparatus to detect ions derived from the sample of ions include instructions operable to cause the apparatus to eject the ions derived from the sample of ions from the ion accumulator to a detector in a direction transverse to the ion path.

61. The computer program product of claim 53, further comprising instructions operable to cause the apparatus to:

filter the sample of ions and the ions with a mass filter before accumulating the ions in steps (b) and (e).

62. The computer program product of claim 53, wherein:

step (c) is performed after step (b).

63. The computer program product of claim 54, further comprising instructions operable to cause the apparatus to:

remove substantially all ions from the ion accumulator before accumulating ions in step (e).

64. The computer program product of claim 53, wherein:

the instructions operable to cause the apparatus to detect ions derived from the sample of ions include instructions operable to cause the apparatus to detect ions in the sample of ions.

65. The computer program product of claim 64, wherein:

the instructions operable to cause the apparatus to introduce ions derived from the accumulated ions into the mass analyzer include instructions operable to cause the apparatus to introduce at least a portion of the accumulated ions into the mass analyzer.

66. The computer program product of claim 64, further comprising instructions operable to cause the apparatus to:

generate product ions from the ions accumulated in step (e);

wherein the instructions operable to cause the apparatus to introduce ions derived from the accumulated ions include instructions operable to cause the apparatus to introduce at least a portion of the product ions into the mass analyzer.

67. The computer program product of claim 54, further comprising instructions operable to cause the apparatus to:

generate product ions from ions in the sample of ions; and

generate product ions from the ions accumulated in step (e); wherein

the instructions operable to cause the apparatus to detect ions derived from the sample of ions include instructions operable to cause the apparatus to detect at least a portion of the product ions generated from the ions in the sample of ions; and

the instructions operable to cause the apparatus to introduce ions derived from the accumulated ions into the mass analyzer include instructions operable to cause the apparatus to introduce into the mass analyzer at least a portion of the product ions generated from the ions accumulated in step (e).

68. The computer program product of claim 53, further comprising instructions operable to cause the apparatus to:

determine a mass spectrum of the ions derived from the accumulated ions.

69. The computer program product of claim 68, wherein:

the instructions operable to cause the apparatus to determine a mass spectrum include instructions operable to cause the apparatus to scale intensities of peaks in the mass spectrum according to the injection time interval.

70. A computer program product tangibly embodied on an information carrier for controlling an ion population to be analyzed in a mass analyzer, the product comprising instructions operable to cause apparatus including a mass analyzer operably coupled to a programmable processor to:

determine an accumulation period representing a time required to accumulate a predetermined population of ions;

accumulate ions for an injection time interval corresponding to the accumulation period; and

introduce ions derived from the accumulated ions into the mass analyzer.

71. A computer program product tangibly embodied on an information carrier for operating a mass analyzer, the product comprising instructions operable to cause apparatus including a mass analyzer operably coupled to a programmable processor to:

control a population of ions to be introduced into the mass analyzer by accumulating ions and introducing ions derived from the accumulated ions into the mass analyzer, the ions being accumulated for a time period determined as a function of an ion accumulation rate and a predetermined population of ions, the accumulation rate representing a flow rate of ions from a source of ions into an ion accumulator.

72. The computer program product of claim 71, wherein:

the accumulation rate is measured while the ions are being accumulated.

73. The computer program product of claim 72, wherein:

the accumulation rate is measured by diverting a portion of an ion beam to a detector while the ions are being accumulated.

74. The computer program product of claim 73, wherein:

diverting a portion of an ion beam includes transmitting a portion of the ion beam to an ion accumulator and detecting a signal representative of a remaining portion of the ion beam while the ions are being accumulated.

75. A computer program product tangibly embodied on an information carrier for operating an analyzing mass analyzer,

the product comprising instructions operable to cause apparatus including a mass analyzer and a programmable processor to:

a) introduce a first sample of ions from a source of ions into a multiple multipole device;

b) accumulate in an ion accumulator ions derived from the first sample of ions during a sampling time interval;

c) detect ions derived from the first sample of ions;

d) determine an injection time interval based on the detecting and the sampling time interval, the injection time interval representing a time interval for obtaining a predetermined population of ions;

e) introduce a second sample of ions from the source of ions into the multiple multipole device;

f) accumulate in the ion accumulator ions derived from the second sample of ions for a time corresponding to the injection time interval; and

g) introduce ions derived from the accumulated ions into the analyzing mass analyzer.

76. A mass analyzing apparatus, comprising:

a source of ions;

a mass analyzer located downstream of the source of ions along an ion path;

an ion accumulator located between the source of ions and the mass analyzer along the ion path;

a detector located to receive ions from the source of ions and configured to generate signals indicative of detecting the received ions; and

a programmable processor in communication with the detector and the ion accumulator, the processor being operable to control a population of ions to be introduced into the mass analyzer by accumulating ions and introducing ions derived from the

accumulated ions into the mass analyzer, the ions being accumulated for a time period determined as a function of an ion accumulation rate and a predetermined optimum population of ions, the accumulation rate representing a flow rate of ions from a source of ions into an ion accumulator.

77. The apparatus of claim 76, wherein:

the processor is operable to measure the accumulation rate while the ions are being accumulated.

78. The apparatus of claim 77, wherein:

the processor is operable to measure the accumulation rate by diverting a portion of an ion beam to a detector while the ions are being accumulated.

79. The apparatus of claim 77, wherein:

diverting a portion of an ion beam includes transmitting a portion of the ion beam to an ion accumulator and detecting a signal representative of a remaining portion of the ion beam while the ions are being accumulated.